PRIMER FOR USERS OF OREGON STATE'S OPEN SHOP OPERATING SYSTEM (OS-3)
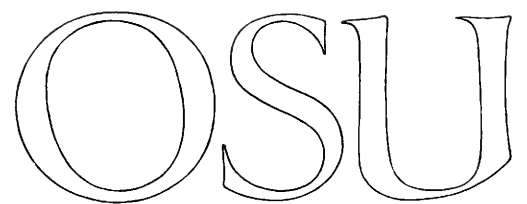
September, 1972

OSU

COMPUTER CENTER

Oregon State University
Corvallis, Oregon 97331

PRIMER FOR USERS

OF OREGON STATE'S

OPEN SHOP OPERATING

SYSTEM (OS-3)

ccm-71-07

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Paragraph A:
The material which follows is presented in a non-sequential order.
You must follow the links from one paragraph to another. If you
attempt to read straight through, you will undoubtedly get bogged
down in some subjects that are of no interest to you. Paragraph
numbers appear at the bottom of each page.

For example, if you have understood the preceding three sentences,
turn to paragraph 0, next page. Otherwise re-read paragraph A.

Paragraph B:
UNDER NO CIRCUMSTANCES SHOULD YOU BE READING THIS SENTENCE! Re-read
paragraph A.

0.

This manual is intended for all new users of OS-3.

OS-3 is the operating system utilized by the OSU Computer Center's
CDC 3300 computer. If you know what an operating system is, skip to
paragraph 2. Otherwise read paragraph 1.

1. Operating System Defined

An "operating system" is a collection of programs that supervises the overall operation of a computer system. Most rankings or orderings of the programs available to a particular computer would place the operating system first. Each user first must establish contact with the computer through the facilities of the operating system. For the case of OS-3, this is called "logging on" and is discussed in detail later. Each user must also conclude his run via OS-3's "LOGOFF" command, and, in the meantime, reach all other software by descending through OS-3's "control mode."

2. OS-3, A Time-Shared Operating System

OS-3 (Oregon State Open Shop Operating System) is a "time-sharing" system; that is, many users are able to use the resources of the system concurrently. For further details on system architecture see paragraph 46. Otherwise, note that OS-3 recognizes two fundamentally different types of users:

and

3. Batch-User Defined

A "batch" user normally submits his job as a deck of punched cards to the personnel in the Computer Center I/O room (207). The deck is "batched" with those of other users, then read through the system's card reader and processed in turn by the computer. In this mode, OS-3 normally reads input data from the card reader, and writes the user's output on the high-speed line printer in the machine room. The deck and printed listing are later returned to the user by the I/O room personnel to complete the cycle. Turn-around time for this entire operation varies from about 30 minutes to several hours, depending upon system load.

****** For further information about running batch jobs, turn to ******

4. On-Line-User Defined

On-line users need not be near the Computer Center in Corvallis, but can utilize the computer's facilities from essentially any place that there is telephone service. A Teletype terminal may be used to communicate with OS-3 over telephone lines. Establishing contact with OS-3 is called "logging on." In order to LOGON - either in a batch run or on-line - you must have a valid job number/user code combination.

****** To learn how to obtain a job number see paragraph 35 ******

****** For a discussion of TV (CRT) terminal use, see para- ******
graph 7

A description of logging on at a Teletype (TTY) follows.

5. Logging On at a Teletype

To LOGON from a Teletype, first be certain that the MODE SELECT knob on the front right-hand corner of the machine is in "LINE" position. Then depress the "CNTL" key (leftmost key, third row from top) and the A key simultaneously. OS-3 will type its special symbol - the pound sign "#" and wait about 20 seconds for you to type your job number, a comma, and then your user code, followed by a carriage return (RETURN key, second key from right end of second row, referred to as "CR"). OS-3 will write masking characters over what you have typed so that no one can read your number, and then print the date, time, and your terminal number. (If, for any reason, you should need to contact the Computer Center regarding a problem with your run, you will need to know the number of your terminal.) While you are logged on you are charged $2/hour for being connected to the computer - even if you do nothing more.

If you made an error in typing your job number or user code, OS-3 will still blot out what you typed, but will write "ILLEGAL JOB/USER NUMBER," then go away and ignore you. To try again, you must repeat the "CNTL-A" step. If you are a super-slow typer and nothing at all happens after you type carriage return (CR key), it's because more than 20 seconds elapsed between the CNTL-A and the CR key activations. Again you must start over with the CNTL-A step. (You will be amazed how fast your typing improves as you practice this way!)

6. Logging Off at a Teletype

Now that you are logged on, and are paying $2/hour for the privilege, the question immediately arises, "How to LOGOFF?" Only OS-3 can log you on and only OS-3 can log you off. No subordinate software understands the meaning of the "LOGOFF" command or takes the proper action if given this command. So, in order to LOGOFF, you must be "in" OS-3's control mode. To assure that you are in this state depress the two keys, CNTL and A together. OS-3 will type #. the pound sign is OS-3's trademark, and signifies that the control mode routine is ready to process a command, such as LOGOFF. If the last character typed was #, simply type "LOGOFF" followed by CR, and OS-3 will print a message telling how many seconds of actual computer time you have used (to the nearest millisecond), the maximum number of disk file blocks and the approximate cost of your run.

****** See paragraph 37 for a discussion of disk storage and ******
paragraph 36 for billing information

To get into OS-3 control mode from any subordinate level, if the Teletype is typing, depress the BREAK key. (Some models also have a BREAK RELEASE key.) If it is not typing, depress CNTL and A together, and again OS-3 will write its #. You then can LOGOFF as described above.

Always be certain you are successfully logged off after each run. Also, turn the Teletype "MODE SELECT" knob from "LINE" to "OFF" to avoid unnecessary wear on motors, belts, etc. If there is any question about whether you are really off-the-air when you want to be, call or contact the I/O room personnel (754-2033); but know your terminal number.

7. TV (CRT) Terminal Use

The Control Data 210 (TV or CRT) terminal communicates directly with the CDC 3300, transmitting up to 250 words - one screen full - of information each time the SEND key is activated. To LOGON at a CRT, clear the screen (clear key - upper leftmost key). Note that # is not a member of the character set for these devices. Use "≠" (upper case "7") as the substitute, and type this followed by your job number, a comma, your user code, and then a "SEND". If OS-3 accepts your number, it will clear the screen and write out the date, time, and terminal number.

8. OS-3 Control Mode at a TV

You are in OS-3 control mode whenever the ≠ symbol appears in the
upper lefthand corner of the screen, and the cursor (line position
pointer) is under the ≠ mark. To get into this configuration if you
are not already there - so that you can LOGOFF, for example - clear
the screen, type in upper case "7" (≠) and press SEND. Whatever was
running will be interrupted and you will be in OS-3 control mode.
Typing "LOGOFF" and pressing SEND will take you off-the-air with a
message about time and disk storage space used, and their monetary
equivalent.

9. Keypunching

Before a potential batch user can submit his card deck to the I/O room
personnel, he must create it by means of the often-frustrating process
called keypunching. Public keypunches are located in room 201 of the
Center. (Note: there are far fewer keypunches than one per student
enrolled in a programming class. Lines get long near the end of the
term.) Learning to keypunch, especially if you don't type, is an
experience. The quickest way to learn is to try doing it. Get help
from someone who seems to know how. If all else fails, there is a
Computer Center publication, "Instruction for Operating the Keypunch
Machine", available in the basement office, room 126 (at 10¢).

No matter how many cards you may have to punch to get one in the following form, OS-3 will not log you on and run your job unless it reads:

$^{7}_{8}$JOB,   in columns 1 to 5, followed by your job number, a comma, and your user code in columns 6 through 16.

(Note: the $^{7}_{8}$ punch in column 1 is accomplished by holding down the multiple punch button while successively hitting the 7 and then the 8 key.) It is also good practice to punch your name or some other identification on the job card, so your deck (and listing) can be returned to you by the I/O room staff.

******** See paragraph 35 for steps in obtaining job number ********

11. OS-3 Control Mode in Batch

It is important for all batch users to realize the significance of a $^7_8$ punch in column 1 of a card read by the system. ANY card with a $^7_8$ punch in column 1 is considered to be intended for the OS-3 control mode routine: Control is returned to this routine from any subordinate level. Thus, those, and only those statements intended for processing by OS-3 itself must have a $^7_8$ punch in column 1.

12. Logging Off a Batch Job

To LOGOFF a batch run, the system must read: $^7_8$LOGOFF in columns 1 to 7. Batch runs are generally cheaper than on-line sessions since there is no "connect-time" in batch, but the advantage of interactive computing is lost. Errors which cause the on-line program to revert to OS-3 control mode, permitting possible recovery, generally cause a batch run to abort; that is, OS-3 simply gives up on the job and goes on to the next $^7_8$JOB card.

13. Time and MFBLKS

Immediately after logging on we are in OS-3 control mode, as signified by the # typed on a teletype, $\neq$ in the upper lefthand corner of our TV screen, or the operating system zipping through our card deck looking for a $\frac{7}{8}$ punch in column 1 if we are running in batch. Two important parameters associated with our run are set to the following values for us by the system when we log on:

    TIME = 60 seconds or amount remaining on job number, whichever
           is smaller.
    MFBLKS - (maximum disk storage file blocks usable this run) =
           100 or limit associated with job number, whichever is
           smaller.

If we attempt to use more than 60 seconds of actual computer time OS-3 will interrupt our run and print "TIME CUT" leaving us in control mode if we are on-line, aborting our run in batch. If we attempt to use more file blocks than are allotted, OS-3 will print "INSUFFICIENT FILE SPACE" and take the same actions.

******** See paragraph 37 for a discussion of file blocks ********

If we know at the time we log on that our run should take more - or less - than 60 seconds or 100 file blocks, we can override these default values by typing in (or including cards with $\frac{7}{8}$ in column 1):

    TIME = <some number of seconds>
and/or
    MFBLKS = <zero to limit on job number>

Unless his job number is completely out of time, an on-line user may simply type:

    TIME = <something larger than current value> (CR)
followed by GO (CR) to resume the run from the point of interruption following a TIME CUT. After the INSUFFICIENT FILE SPACE message, the user types - as two separate commands -

    MFBLKS = <something larger than current value> (CR)

and

GO (CR)

to resume the run.   Batch jobs are <u>aborted</u>, so be certain your values are set large enough when you submit a deck for processing.

Note: All commands entered at a teletype for processing by OS-3 must be actually transmitted to OS-3 by pressing CR.   From here on in this manual we will <u>not</u> continue to write CR after every example, but you <u>must</u> actually type it to end each command.

On-line users can ask the control mode routine how much time or how many file blocks have been used, by typing TIME or MFBLKS, omitting the "=<value>" portion.   The batch user can get the same information printed by including corresponding cards.

14.   Input/Output Units

Associating "logical" unit numbers (LUNs) with physical Input/Output
(I/O) devices is another function of OS-3. So, before we consider
descending from OS-3 control mode to some "useful" software, we should
consider I/O under this operating system.

********** To bypass this material, skip to paragraph 18 **********

All users of OS-3 can output information to the line printer (LP),
card punch (PUN), plotter (PLOT), high-speed paper tape punch (PTP),
sequential or random-access disk storage file (FILE or RAF). An on-
line user can also output data to his Teletype or TV. (PTP is <u>not</u>
the tape punch on your Teletype.)

********** For a discussion of paper tape, see paragraph 42 **********

Input units available to all users are FILES and RAFs. The on-line
user also has his terminal keyboard, while the batch (and remote-batch)
user has the card reader for input, and the magnetic tape drives for
input and/or output.

******** For a discussion of remote-batch, see paragraph 45 ********
                   for magnetic tape, paragraph 44

15. I/O Units, LUNs, and the EQUIP Command

Each user has up to 100 logical I/O devices available. ("Logical because several LUNs can be equipped, say, as line printers, although there is only one physical line printer. Note also that information sent to a "line printer", "card punch", "plotter", or "PTP" is actually stored temporarily on disk. So, you can run out of "scratch" file blocks although you think you are not using disk at all.)

A control mode statement of the form $\binom{7}{8}$ in column 1 for batch):

$$^{7}_{8}EQUIP,<LUN> = <device\ type\ or\ previously\ equipped\ LUN>$$

is used to establish the association between a LUN and a physical device.

********** For a discussion of LUNs equipped at LOGON **********
<div align="center">

in batch, see paragraph 16

on-line, see paragraph 17

</div>

16. Standard LUNs in BATCH

LUNs 60 and 61 are OS-3's standard input and output units, respec-
tively. For batch, this means that, when your job is logged on
(i.e., when OS-3 reads your "$^7_8$JOB, job number, user code" card),
LUN 60 is equipped to the card reader, and LUN 61 to the line printer.
All other units must be explicitly equipped while in control mode -
that is, before starting a run of a library or user program which
reads from or writes on LUNs other than 60 and 61. Attempting to
access an unequipped unit in batch causes the job to ABORT.

17. Standard LUNs for Terminal Users

The on-line user's standard input unit - LUN 60 - is the keyboard of
his terminal. His standard output unit - LUN 61 - is the printing
element of his teletypewriter or the screen of his TV. LUN 100 is
also equipped to the terminal for both reading and writing, and cannot
be unequipped. Attempting to access an unequipped LUN interrupts the
running program; the system writes "LUN X UNDEFINED" and leaves
itself in control mode. The user may then EQUIP the LUN and type GO
to resume the interrupted program.

18. Saved Files

All job numbers have associated a third limiting parameter in addition
to time and scratch file blocks, namely save able file blocks.
"Save" in this context means between runs - between logging off and
next logging on. To save information presently on a scratch file, the
user instructs OS-3 to

      SAVE,<LUN>=<NAME>

where LUN is the logical unit number of the scratch file, and NAME is
a string of alphanumeric characters, the first alphabetic. Once you
have saved a file under a name, you may subsequently "equip the file";
that is, cause OS-3 to associate a particular LUN with the file by
instructing the control mode routine to

      EQUIP,<LUN>=<NAME>.

The data on the saved file may be a program (source, binary, or overlay),
or may be read by a program (of yours, for example) which reads from
that particular LUN. When you logoff or otherwise unequip the LUN, the
saved file survives. But all other LUNs - in particular, all scratch
files - are unequipped and lost to the user when he LOGS OFF.

19.   Line Printer Use from a Terminal: The LABEL Command

The on-line user may wish to use the high-speed line printer in the
machine room of the Computer Center to obtain copies of large amounts
of information, rather than having this typed out by the much slower
Teletype.   To obtain punched card decks, the on-line user must, of
course, utilize the system's card punch.   In order to permit identi-
fication of these outputs by the I/0 room personnel, a control mode
command "LABEL" is used:

        LABEL,<LUN>/<message>

Note: The LUN must first be equipped.

Example: EQUIP,40=LP
           LABEL,40/SAVE FOR JONES

"SAVE FOR JONES" (or any other single-line message as entered by the
user) will have been printed across the top of the first page of the
printed listing.   The card punch labeling routine punches up to
eight (8) characters in block letters across one card.   If the user
wishes his punched output interpreted (printed across the top of the
cards) he might use:

Example: EQUIP,77=PUN
           LABEL,77/INTERP   calls for interpretation of deck
           LABEL,77/123456   and gives job number to charge to
           LABEL,77/SMITH   user's name

Information to be written on a LP or PUN is first stored as a scratch
disk file.   When the user unequips the LUN (or LOGS OFF, unequipping
all LUNs) the scratch file is transferred to a queue (waiting line)
of files waiting to be punched or printed.   At this point, the user
has his scratch file blocks back and can re-use them.

20. RELEASE Unwanted Output

Suppose you have equipped and labeled a PUN or LP, and have written some information on the LUN which you subsequently do <u>not</u> wish to output. Clearly, unequipping the LUN will have the reverse effect - the bad information (technical term: "garbage") will be output immediately (as far as the user is concerned) if the LUN is unequipped. Instead, the RELEASE command is used to return the file to an empty configuration (including label) so that nothing is output when the LUN is unequipped.

Form: RELEASE,<LUN>

21. OS-3 Reference Manual

Further information about commands recognized by the OS-3 control mode
routine may be found in the "OS-3 Reference Manual", ccm-70-8R, July,
1971. We now contemplate a descent from OS-3 control mode to some
subordinate level of software. How might we categorize these sub-
ordinate levels?

22. Library Programs

There are library programs, which can be called by typing a single key word, sometimes followed by a string of parameters. These include the language translator programs: ALGOL, BASIC, COMPASS, FORTRAN, OSCAR, RADAR, and COBOL. Information for each of these is available in separate documents. (See Appendix A.)

23. Utilities

Next, there are utility programs called directly from OS-3 control mode: COPY, COSY, DIRECTORY, DUMP, EDIT, LABEL, and LOAD.

COPY - Copies information from one file, LUN, or media to another. Documented in OS-3 Reference Manual, ccm-70-8R, page 20.

COSY - Local version of CDC's Compressed Symbolic Editor for compressing stored information. See manual ccm-70-6.

DIRECTORY - Prints list of user's saved file names as of previous day. Written up in OS-3 Reference Manual, ccm-70-8R, page 27.

DUMP - Core dump routine, see OS-3 Reference Manual, page 28.

EDIT - An on-line (only) editing routine for creation and alteration of files. Separate manual ccm-70-7R.

LABEL - See paragraph 19, this manual, or OS-3 Reference Manual, page 39.

LOAD - Loads relocatable "binary decks" - pseudo object language programs in relocatable form, see OS-3 Reference Manual, page 41.

The execution of any of the options mentioned here or in paragraph 22 DESTROYS the status of a previously interrupted program: It cannot be restarted by typing GO.

24.   Et Cetera

The remaining commands recognized by the OS-3 control mode routine
are principally file manipulation and status changing or checking
commands.   Consult the OS-3 Reference Manual for further details.
Note that these remaining commands are processed directly by the
control mode routine; your interrupted program is not destroyed by
execution of the command, and so may be restarted with a GO.

25. Examples (Beware)

Examples given in a manual such as this are often misleading, inade-
quate, confusing, and/or out-of-date. Such an example follows:

(caveat emptor)

The user cautiously approaches the
                ***** Keypunch, turn to paragraph 26 *****
                ***** Teletype, turn to paragraph 27 *****
                *****   TV, turn to paragraph 33   *****

sits down, turns the keypunch on, waits for it to warm up, feeds and registers a card, and types

Col. 1

${}^{7}_{8}$JOB,123456,USER,SAVE FOR MARTIN

${}^{7}_{8}$TIME=15

${}^{7}_{8}$FORTRAN,L,X

77
88

The double 7,8 End-of-File card is required to set up a successful exit from the compiler. If the system should read a ${}^{7}_{8}$<command> card instead, control would immediately be taken away from the compiler and the final subprogram would not be completely compiled.

Continuing the example now; the user might

${}^{7}_{8}$DELETE,BINDECK

${}^{7}_{8}$SAVE,56=BINDECK

${}^{7}_{8}$EQUIP,1=INFILE

${}^{7}_{8}$LOAD,56,SUBPROG1,SUBPROG2,L=MYLIBR

Col. 1   RUN

${}^{7}_{8}$LOGOFF

Having punched and checked all these cards, the user takes the deck to the I/O room (CC 207), fills out a cover card, and submits the deck as a batch job.

Let's surmise what we can about this program, even though the source decks are not shown. First, it is expected to be a short run - no more than 15 seconds. The user wants a listing of the source decks, and wants the binary (object) decks written on LUN 56 (by default). He remembers the $\frac{77}{88}$ card following his final source deck. Apparently he had saved a binary deck as a saved file at some prior time, and now wishes to save the new binary output from the compiler under the same name - BINDECK (of course the old information will be lost).

He then sets up the I/O units for the actual running of his program. The program presumably reads data from LUN 1. He equips this LUN to a saved file named INFILE. (Of course, we cannot be certain that the program does not write on INFILE. It could.)

Now he is ready to load and run his program. But it apparently requires two subprograms already in binary form, SUBPROG1 and SUBPROG2, plus one or more additional programs from a library called MYLIBR. The loader hopefully will get all of these programs loaded into the user's 32,768 words of memory, then come back to read the <u>LOADER</u> control card

<u>Col. 1</u>
"RUN" [Note: <u>NO</u> $\frac{7}{8}$ punch]

The loader will then give control to the user's main program. Almost any error occurring during the actual run will cause the job to abort, so it behooves the batch user to be very thorough in checking out his programs and the overall structure of the deck he submits.

****** The Teletype example follows. To skip it, turn to ******

sits down, turns the knob above his right knee to the "LINE" position, pushes CNTL and A at the same time, and observes the # typed by OS-3. He then enters 123456,USER and pushes CR. OS-3 approves of this job number/user code combination, and types out the date, time, and terminal number, and then another #, its trademark. The user is logged on. He wishes to create a source program, save it as a file, then compile, test, and run it, and have its output printed on the line printer in the machine room.

First, to create the source program, he calls the editor, by typing EDIT (CR).

The editor responds with its special symbol, "]" and the user knows he is in edit command mode. To begin a new body of text in the editor's work area, he types INPUT (CR), and the editor responds with a line number

        001:
The user then enters the first line ("card") of his source code.

        001:        PROGRAM DEMO

followed by a CR, and the editor types out the next sequence number and waits for another line, etc.

Question:	How to get out of input mode, back to edit command mode (not OS-3 control mode)?
Answer:	Type either ESCape, ALTMODE, or CNTL and W.
Question:	How to get out of the editor completely, i.e., back to OS-3 control mode.
Answer:	CNTL-A or BREAK or the edit command "EXIT".
Question:	How to get back to the editor from OS-3 control mode without destroying what you've already done with edit.
Answer:	Do NOT type EDIT. This would give you a fresh copy of the editor, clobbering what you had already typed in. Instead, type MI (for "Manual Interrupt").

28. MI versus GO

The same concept applies if you were in OSCAR or BASIC, and got returned to OS-3 control mode. MI will put you back into the <u>command</u> level of the interrupted program without disrupting anything. GO will resume execution of your program, or continue an edit or I/O operation that was in progress when the control mode interruption occurred.

****** Continue reading paragraph 29 to complete the teletype ******
            example. Otherwise turn to paragraph 31

29. More about EDIT

Having typed in the last line of his source code, the user wishes to
escape from EDIT's input mode back to its command mode, and so types
either CNTL-W, ALT MODE, or ESC. (All teletypes have a CNTL key and
a W.)

The Editor once again responds with its symbol "]". The user must
then cause the editor to write the text he has typed into its work
area on disk, for reading later by the FORTRAN compiler. The Editor
can write in three different formats (BCD - "Binary Coded Decimal"
is a particular code used by the CDC 3300):

1) variable or fixed length BCD records (OUT command)
2) compressed BCD (FILE command)
3) COSY (COUT command)

Since COSY output is the most compressed, requiring the least disk
space, the user chooses to use·

        ]COUT,DEMO

If no saved file named DEMO existed, one is created and the contents
of the edit work area are written on the file in COSY format. The
user now has a saved file named DEMO with a FORTRAN source program
named DEMO written on it. The choice of the program and the file
names are arbitrary: they need not be the same.

The next step is to try compiling the source code. If the user
wants the compiler to provide a printed listing, he may have this
typed on the teletype by including the L parameter in the calling
statement.

Most FORTRAN listings are too long for an impatient TTY user, so it
is common practice to "send" such listings to the line printer. This
is done by

        EQUIP,<lun>=LP
say   EQUIP,5=LP

If he then calls FORTRAN - the other compilers or assemblers are
called in an analagous manner - with, for example

      FORTRAN,I=DEMO,L=5
the text will be written on an <u>unlabeled</u> listing which will be dif-
ficult to recover from the I/O room. Instead, after equipping the LP
he should

      LABEL,5/SAVE FOR THOMAS
and then use the compiler.

If the compiler detects syntax errors in the source statements, the
user may fix the source program by calling EDIT, then reading the
COSY records into the edit work area by typing "FIN,DEMO". He may
list, change, insert, and delete lines, and then <u>rewrite</u> the infor-
mation to disk with another COUT command. Presumably the listing
created by the first compilation is unwanted. The user should
RELEASE,5 rather than unequipping it, then (re)LABEL,5/SAVE FOR
USER, and call the compiler again.

Suppose this time there are no errors detected. The user then has a
"clean" listing available for printing when he unequips 5 or logs off.
But he has no runable machine code - no "object program" or "binary
deck". To get the compiler to produce this additional output, the
user should have included either the X parameter, which causes the
compiler to write (on LUN 56) relocatable binary records logically
equivalent to the FORTRAN source, or the R parameter which causes
the same output on 56, followed by a BCD record "RUN", followed by
a direct call to the loader. Thus the R parameter causes a "load-
and-go" run of the object code. (If separately compiled subprograms
or non-standard libraries are to be used, the R parameter method will
not work. The user must supply an explicit call to the loader in
this case.)

30. LOADING and Running

Let us suppose the user has some subprograms already compiled into "binary deck" relocatable form, and/or a (non-standard) library he wishes to load subprograms from. He therefore has used the X parameter in his compiler calling statement:

    FORTRAN,I=DEMO,L=5,X

The compiler has read the source program statements from the saved file named DEMO, written a listing of these on the line printer (LUN 5), and written relocatable object code on LUN 56. The user may now call the loader:

    LOAD,56,SUBPROG1,SUBPROG2,L=MYLIBR

His main program from LUN 56, the two subprograms, plus anything else needed from MYLIBR, then the standard FORTRAN library will be loaded and linked together to operate as one large program. Control will then be passed to the user's main program, and it will do its thing. A message "END OF FORTRAN EXECUTION" will be typed when (if) the program makes a normal exit back to OS-3. Otherwise, some other message will appear and the user will be returned to OS-3 control mode.

31. TIME CUT

For instance, suppose the user has not changed the time limit of 60 seconds set for him by OS-3 at LOGON. After running the user's job - including edit and compiler time - for 60 seconds, OS-3 will interrupt the user's object program, print "TIME CUT", and leave the user in control mode.

Question: What to do?
Answer: See paragraph 13

32. CONSULTANT

There are, of course, many things that might go wrong during
the execution of the user's program. No publication is long enough
- no author clever enough - to think of them all. If your program
blows up in a manner which remains mysterious to you, although you
have checked the references and asked all your friends, the Computer
Center provides a staff consultant during school terms, weekday
afternoons from 1 to 4 o'clock in CC room 211.

33. TV Example

sits down, clears the screen, and observes that the cursor - left end of string of dashed lines - is in the upper left-hand corner of the screen. The user then types ≠ (upper case 7) followed by his job number/user code, and pushes SEND. If the number was valid, OS-3 clears the screen and writes the date, time, and terminal number; the user is now logged on. Suppose he wishes to do the same things the TTY user did (see paragraph 27). The TV user also calls the editor by typing EDIT, but he may think in terms of screens-full, rather than by line. For example, after noting the] in the upper left-hand corner (the editor's trademark), the user might type "INPUT" and then push the RETURN key (to drop the cursor down to the next line) and begin entering text.

(The CRT's buffer holds 20 lines, each 50 characters long.) After entering as many lines as desired (<20), the user presses SEND, and the entire buffer full of text is transmitted to the editor's work area in main memory of the CDC 3300. If more text is to be added, the APPEND command must be used, rather than INPUT. (Otherwise the first input will be clobbered by the second, etc.)

After entering all the text, the user may have it listed, a screenful at a time, by typing LIST, followed by repeated SENDs. Insertions, deletions, and replacement of lines is accomplished in essentially the same manner as on the TTY. For further details about the editor, consult ccm-70-7.

Question: How to get into OS-3 control mode from edit on a TV?
Answer: Clear the screen, type ≠, and SEND. You are then in control mode.
Question: How to get back to edit from OS-3 control mode?
Answer: Clear the screen, type MI, and SEND.

********* See paragraph 28 for a comparison of MI and GO *********
or paragraph 34 to complete the manual.

34. Critique

This is the end of the primer. The paragraphs which follow represent branches you might have taken during your travels through the text. Please take a few minutes to complete the following critique.

1. This manual is: Very good
                              Good
                              Fair
                              Poor
                              Terrible

2. It would be better if:

3. The following items should be covered:
   a) but are omitted _____
   b) more thoroughly _____
   c) less thoroughly _____
   d) not at all _____

Please return this - in a plain brown envelope, if you like - to the Computer Center, ATTENTION: Publications Committee.

35. Job Numbers

Job numbers are obtained in room 126 in the basement of the Center:
Phone 2494.

OS-3 operates on a pay-as-you-go basis. The key for any user is $$
- TIME is money. Unsponsored research grants are sometimes available
to destitute but worthy students (usually graduate students) and
faculty members. Staff members may use grant or departmental funds.
Once it has been determined that a job number is to be issued to you,
the Center will assign the number, you may select the four-character
user code, and the system will honor the combination the following day.

The three parameters associated with each job number/user code are:

TIME = total number CPU seconds authorized

"Scratch" File Space = amount of disk storage space usable
during one run (exclusive of Save File Blocks)

Save(able) File Space = amount of disk storage you may occupy
between LOGOFF and next Logging ON.

********** Paragraphs 36 and 37 discuss costs and billings **********

36. Costs

Usage of the system is measured in $$ and converted to equivalent CPU (Central Processing Unit) time.

CPU TIME costs $5/minute = 8 1/3 cents per second. Terminal connect time is $2/hour. Disk storage space is 15¢ per file block per month. (See next paragraph for "What's a file block?") It costs 15¢ to read 100 cards; 25¢ for the card punch (not a keypunch) to punch 100 cards. The line printer sells for 12 1/2 cents per 100 lines.

Accounting is done in dollars and cents and the time equivalent adjusted accordingly. Thus, if you LOGON with 100 seconds on your job number, use 10 seconds of CPU time, 1/2 hour of terminal time, use the line printer or punch, etc., then logoff and logon again, you may find that you have only 75 seconds of time left. Twelve of the 15 mystery seconds cover the $1 charge for the 1/2 hour terminal hook-up. The remaining 3 seconds must be for lines printed on the printer or cards punched by the system's card punch, etc. It is even possible to wind up with negative seconds - the 4th dimension at OSU.

Detailed summaries of the amount of each resource used during each run can be obtained with the monthly billing.

To get more time ($) added to your number, call or visit the office mentioned in paragraph 35.

37. File Block Defined

A file block is a measure of physical disk storage. One file block
is equivalent to 510 words of CDC 3300 core storage. Data is read
and written in units called records. Each record may contain the
same number of words, ("fixed-length" records) or the number of words
per record may vary ("variable-length" records). In either case,
OS-3 uses an extra word at each end of each record to tell how long
the record is. So, for example, if your job number has a scratch
file block limit of 50 file blocks, and you want to compute the number
of card image records this represents, the numbers are as follows:

$$\frac{510 \text{ words/file block X 50 file blocks}}{20 + 2 \text{ words/record}} = 1159 \text{ records}$$

As a second example, suppose your job number has a save file block
limit of 10. Then you may create a maximum of 9 _empty_ saved files –
the 10 is an upper bound not actually attainable, and each saved
file name charged to your job number/user code deducts one from your
available number of save file blocks. A non-empty saved file – one
with at least one record – takes up at least two file blocks: the
automatically used one plus at least one more for the actual data
records.

38. File Naming Conventions

The name that a file is saved under is significant. If the first character of the name is anything other than * or ↑, then the file is "private" and is accessible only to the job number/user code combination that created it.

A file whose name begins with ↑ is accessible by any user code under the job number which created it, while a file whose name begins with * is accessible to all users of the system. ↑ files are called "semi-public" or "semi-private" depending on the optimism of the describer. * files are called "public" and should be "file-protected". That is, made read-only (non-writeable) by using the control mode command FP,<name>. The command RFP may be used to remove file protection if the file was created under the same job number, user code.

File blocks in use are billed at 15¢ per block per month.

Question: How to unsave a saved file?

Answer: The command DELETE,<name> will dispose of an unprotected saved file.

The command DESTROY,<name> will eliminate any private file (which belongs to the user, of course) even if it is file protected.

Only the creator of an ↑ or * file can remove file protection.

39.   Program Library Catalogue

Programs to do almost anything reasonable have been written by someone
or other and may be available as overlays or as binary and/or source
decks on saved public files. A "complete" list of these may be found
in the Center's Program Library Catalogue, ccm-70-27, September, 1970.
Changes too recent to appear in this volumn are on a public file,
*LIBRARY with the most recent updates first. This file may be
copied at a TTY or TV, or out to a LP.

Some programs are documented in separate manuals:

Examples include:

    SORT   ccm-71-06
and MERGE   ccm-70-17

40. Overlays

Overlays are called from OS-3 control mode by simply typing the name of the file the overlay is saved on. That is, if the control mode routine is given a command which is not in its vocabulary, it searches the file directory, and, if a saved file with the same name is found, OS-3 attempts to load the file as an overlay. An overlay is a program in absolute, nonrelocatable machine code, created by a call to the loader of the form:

LOAD,<LUNS>,<FILES>,<LIBRARIES>,0=<overlay name>.

41.   Some Useful Overlays on Public Files

For example, *SCOOP contains an overlay which prints out the time
remaining on the user's job number. *LL prints a list of currently
equipped LUNs. *ASSEM is the new 3300 assembler, etc. Many public
overlays of this type exist from moment to moment at the whim of
their creator. Those which are documented in the Program Library
Catalogue are under the control of the Center, and so will probably
exist when you want to use them. Others, contributed by private
individuals, are largely undocumented, must be learned about through
hearsay, and used at the user's risk.

42.   Paper Tape, Fast and Slow

Paper tape may be copied to a file at relatively high speed by sub-
mitting the tape to the I/O room personnel, so that they may have it
read by the reader attached to the PDP-8. The cost is 25¢ per 100
input blocks, 1 input block = 62 characters. Such data must then be
massaged into the 3300's internal code by available software. Contact
Ron Davis (Room 224B, phone 2494) or the I/O room personnel for
details.

Some Teletypes also have paper tape readers and punches attached to
them. To punch what you or the machine is typing, simply push the
'ON' button on the tape punch.

To recover information from a paper tape, get into EDIT, type 'TAPE',
and then having threaded your tape into the reader, move the lever
from 'STOP' to 'START'. The information will be copied into the edit
work area in core storage; then you can OUT it to a scratch or saved
disk file for further use.

43. Fast Paper Tape Output

Data may be copied out to the high-speed paper tape punch on the
PDP-8 by equipping a LUN = PTP, and labeling the LUN with *PTLABEL.
Such data is first written as a scratch file, and so may generate
an INSUFFICIENT FILE SPACE message.

44. Magnetic Tape

There are four magnetic tape drives attached to the system at present. Normally these are accessible only to batch and remote-batch (see paragraph 45) users. To equip a LUN to a tape drive, include a card

$^7_8$EQUIP,<LUN>=MT<number> AT <density><comments>.

NOTE: The blanks delimiting the word "AT" are required. Density may be specified as 200, 556, or 800. Comments usually include whether the tape should be write-enabled, and perhaps some further identifying information to reduce the probability of operator error. No software checks of tape labels, etc., are made by OS-3. If you desire label checking you must write your own code.

A remote terminal user may avoid the \$2/hour connect charge, and/or
utilize the magnetic tape units by setting up a simulated batch job
from his terminal. He must create a file of card images which look
exactly like regular batch cards, except that the $^7_8$ punches are
replaced by left bracket, [. This is most easily done with the
editor. For example, to set up a remote-batch run of the binary
deck saved in the batch example, paragraph 16, the user might logon
and call EDIT, then type

```
]INPUT
001:   [JOB,123456,USER,SAVE FOR SPIRO
002:   [TIME=200
003:   [MFBLKS=500
004:   [LOAD,BINDECK,SUBPROG1,SUBPROG2,L=MYLIBR
005:   RUN
006:   [DELETE,OUTFILE
007:   [SAVE,41=OUTFILE   No 'Lun is not a file'
008:   [LOGOFF
009:   ESC
```

Note: Typing ESC, or ALTMODE, (or SEND on a TV) gets us back to the
       editor's command mode.

We now must OUT the text to a special type of file called a TASK,
which OS-3 will subsequently treat as a batch card deck submitted in
the normal way.

This text, currently in the editor's work area in core storage, is
to be written out to a TASK unit in card image format. The correct
editor command is

     OUT,TASK

The TASK is automatically unequipped and the card images join a queue
of remote batch decks. From then on, the job is processed as a batch
job. All LUNs are equipped as in batch, the same errors abort the

job, etc. Output for LUN 61 will go to the line printer in Corvallis.
Really remote users who may later want to copy the output from such a
job to their TTYs should define LUN 61 as a saved file. This can be
done in a special way by putting

  61 = <NAME> in the JOB card.

Example:
    [JOB,123456,USER,61 = PRNTFILE,SAVE FOR SPIRO.

Records normally printed will instead be written on the saved file
PRNTFILE up to the user's save file block limit. If this limit is
exceeded, the job will abort.

We have just OUTed our TASK, and are still logged on at the terminal.
A CNTL-A (or CLEAR,≠,SEND on the TV) will put us in OS-3 control mode
so we can LOGOFF. If we remain logged on at the terminal, we must be
certain that none of the saved files used by the remote batch job are
also equipped by the on-line job. Otherwise the remote batch job
will abort with a message about "FILE BUSY". A way to make sure no
files are still equipped is to use the 'RESET' command in the editor
before OUTing the file.

OS-3 runs on a hardware configuration which consists of a Control
Data 3300 and a Digital Equipment Corporation PDP-8, a much smaller
computer which interfaces the 3300 with assorted Teletypes and
handles the high-speed paper tape punch and reader.

A "bit" or binary digit is the fundamental unit of information in a
digital computer. Each bit answers a single yes-no, off-on, one-zero
question. In the 3300, PDP-8, and most contemporary machines, "bits"
are implemented in hardware in the form of ferrite cores - tiny
doughnut shaped ceramic rings with a magnetic iron compound which
gives the core the properties of a magnet. Thus, when magnetized in
say the clockwise-is-north direction, the core may represent 1; when
magnetized oppositely it represents 0.

Since one bit is a very small amount of information, most computers
work with larger collections of bits called "words". Each word in
the CDC 3300 is 24-bits long. Each quarter-word or 6 bits is called
a "character". Core memory may be accessed one or two words at a
time, or one character at a time. The 3300 uses the 6-bit binary
coded decimal (BCD) code to represent characters internally.

Many users are able to use the resources of the system seemingly
simultaneously because core memory of the 3300 is divided into blocks
called "pages" of 2048 words each. Only one page of a given user's
program need be in physical memory of the machine for that user's
program to be run - at least partially. The remainder of his pages
may be kept on a disk file, and swapped in and out of core storage
as needed. In fact, if the load on the system should become so great
that not even one of a given user's pages can fit in core, that job
may be "delayed" - all the pages left on disk for a time. The job
is said to be "swapped out".

Each user has access to at least 16 pages, or 32,768 words, of "virtual" memory, as contrasted with actual physical core memory of the 3300. The operating system, OS-3, gives each job a quantum of time to run, then passes control of the computer to the next active job. Cycling around this circular list of jobs, OS-3 is usually able to provide sufficiently quick response so that each user thinks he has the system pretty much to himself.

APPENDIX A

APPENDIX A

Other Computer Center Publications:

Title	Number
OS-3 Reference Manual (Revised July 1971)	ccm-70-8
OS-3 Editor Manual	ccm-70-7
BASIC User's Manual	ccm-71-08
Brief Description of OSCAR (4th revision, Jan. 71)	ccm-69-25R
EZPLOT	cc-69-18
RADAR	ccm-70-9
Sort/Merge for OS-3	33-68-37R
COSY for OS-3	ccm-70-6
Program Library Catalog	ccm-70-21
FORTRAN: Entering, Editing, and Running from Remote Units under OS-3	ccm-68-39

> Note that the principal reference for FORTRAN, as well as for COMPASS, COBOL, and ALGOL, is the appropriate Control Data Corporation publication. These are also available for purchase in CC 126.

A complete set of Computer Center publications is on display outside the office (CC 126) in the basement of the Center.

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